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09/463,643	05/01/2000	SHUJI NAKAMURA	NICHIA-00700	6608

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EXAMINER

BAUMEISTER, BRADLEY W

ART UNIT	PAPER NUMBER
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2815

DATE MAILED: 07/15/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

# Office Action Summary

Application No.

09/463,643

Applicant(s)

Nakamura et al.

Examiner

B. William Baumeister

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

## Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136 (a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☒ Responsive to communication(s) filed on Mar 27, 2003.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

## Disposition of Claims

- 4) ☒ Claim(s) 33, 34, 41, 43, 44, and 46-61 is/are pending in the application.
- 4a) Of the above, claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 33, 34, 41, 43, 44, and 46-61 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claims \_\_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.  
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

## Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
a) ☐ All b) ☐ Some\* c) ☐ None of:  
1. ☐ Certified copies of the priority documents have been received.  
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.  
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).  
\*See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).  
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

## Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s). 21, 23 6) ☐ Other:

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## **DETAILED ACTION**

### ***Claim Objections***

1. Claims 46, 47, 53, 54, 60 and 61 are objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim.

Applicant is required to cancel the claim(s), or amend the claim(s) to place the claim(s) in proper dependent form, or rewrite the claim(s) in independent form. The independent claims from which the present claims depend set forth that the second layer is an n-type *single* layer. The present claims then broaden the scope by setting forth that the second layer is a superlattice.

### ***Claim Rejections - 35 USC § 112***

2. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

3. Claims 33, 34, 41-44 and 46-61 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

a. A broad range or limitation together with a narrow range or limitation that falls within the broad range or limitation (in the same claim) is considered indefinite, since the resulting claim does not clearly set forth the metes and bounds of the patent protection desired. Note the explanation given by the Board of Patent Appeals and Interferences in *Ex parte Wu*, 10 USPQ2d

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2031, 2033 (Bd. Pat. App. & Inter. 1989), as to where broad language is followed by "such as" and then narrow language. The Board stated that this can render a claim indefinite by raising a question or doubt as to whether the feature introduced by such language is (a) merely exemplary of the remainder of the claim, and therefore not required, or (b) a required feature of the claims. Note also, for example, the decisions of *Ex parte Steigewald*, 131 USPQ 74 (Bd. App. 1961); *Ex parte Hall*, 83 USPQ 38 (Bd. App. 1948); and *Ex parte Hasche*, 86 USPQ 481 (Bd. App. 1949). In the present instance, each of independent claims 33, 34, 48, 49, 55 and 56 recites the broad recitation "wherein said second nitride semiconductor layer is an n-type single layer having a thickness within a range of from 0.1 to 20 microns," and the claim also recites "wherein said second nitride semiconductor layer is a thick layer of which thickness is set [sic: to] 1 micron or more..." which is the narrower statement of the range/limitation.

b. The term "said third nitride semiconductor layer is a thin layer" in each of claims 33, 48 and 55 is a relative term which renders the claim indefinite. The term "thin" is not defined by the claim, the specification does not provide a standard for ascertaining the requisite degree, and one of ordinary skill in the art would not be reasonably apprised of the scope of the invention. Unlike independent claims 34, 49, and 56 setting forth that the thin layer does not exceed 0.5 microns, claims 33, 48 and 55 do not set forth any objective standards for what constitutes "thin." Further, in light of the 112-2nd issue relating to how thick the second, thick layer may be, no relative standard can be implied for how thick the thin layer may be.

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c. Regarding claims 46, 47, 53, 54, 60 and 61, claim 46, 53 and 60 each recites the limitation "[the second layer is] a super lattice layer made by laminating the [sic: a?] low doped nitride semiconductor layer of n-type impurity and the [sic: a?] high doped nitride semiconductor layers of n-type impurity." There is insufficient antecedent basis for these limitation in the claim. Specifically, it is unclear whether the recitation of "the low doped [layer]" and "the high doped [layer]" is intended to refer to the first and/or third layers and the second layer, respectively, or alternatively whether the first and third layers are formed in addition to the low- and high-doped layers of the second layer.

***Claim Rejections - 35 USC § 103***

4. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

5. Insofar as definite, claims 33, 34, 41, 43, 44 and 46-59 are rejected under 35 U.S.C. 103(a) as being unpatentable over Itaya et al. '017 (previously made of record) in view of Bruno '604 (previously made of record). See the tenth embodiment of FIG 19 wherein Itaya teaches the employment of a doped (Al)GaN superlattice for injecting current to the active layer at low resistance by a pseudo two-dimensional electron gas (col. 24, lines 48-52). The embodiment includes an n-AlGaIn clad 25. Itaya does not teach that the superlattice may include undoped wells.

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a. Bruno teaches that (Al)GaN superlattices can be modulation-doped such that the dopant atoms are restricted to the barrier layers (col. 2, lines 59-60)--i.e., the GaN wells are undoped--for the purpose of reducing scattering and increasing mobility. It would have been obvious to one of ordinary skill in the art at the time of the invention to have provided a mod-doped superlattice for the superlattice 24 in the light emitter of Itaya for the purpose of reducing scattering and increasing mobility/reducing resistance as taught by Bruno.

b. As such, the .3 micron u-HT-GaN layer 40 (and/or the 30 nm u-LT-AlGaN layer 22) reads on the first layer; the 1.5 micron,  $1 \times 10^{18}$  n-doped AlGaN layer 23 reads on the second layer; and any one of the 50-angstrom GaN wells of superlattice 24 (such as the lowest one which is adjacent to the second, n-AlGaN layer 23)--when modified to be undoped according to Bruno--reads on the third layer.

c. Regarding claims 55, 56 and those depending therefrom all of which set forth that the first through third layers contact each other, first layer 40 contacts second layer 23. Also, Itaya discloses that the superlattice is composed of 50 pairs of wells and barriers (col. 24, lines 20-) indicating the well is formed first, and is therefor in contact with the second layer. However, even if the reference must be interpreted so narrowly as not sufficiently implying this fact, it would have been obvious to one of ordinary skill in the art at the time of the invention to have formed the well--as opposed to the barrier--first so as to be adjacent to the second layer because the barrier and the second layer are both composed of Al<sub>0.15</sub>Ga<sub>0.85</sub>N and placing a barrier adjacent to the second layer 23 would have such negligible effect as to not be necessary and thereby

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making the placement of the well adjacent the second layer more cost effective from a manufacturing standpoint.

d. Claims 41, 50 and 57 further requires that the third layer be composed of InGaN, and as such, the u-GaN well of Itaya/Bruno does not read on this limitation when interpreted as constituting the third layer. Nonetheless, it was well known to those of ordinary skill in the art at the time of the invention that InGaN has a smaller bandgap than GaN, and it was known by those skilled in the art how to form a (Al)GaN-barrier/InGaN-well superlattice. It would have been obvious to one of ordinary skill in the art at the time of the invention to have composed the mod-doped superlattice 24 of Itaya/Bruno with u-InGaN instead of u-GaN for the purpose of further improving upon the pseudo two-dimensional electron gas effects of the superlattice: reducing the well's effective bandgap to increase the carrier mobility/decrease the carrier resistance and thereby further increase the current injection into the active layer as desired by Itaya.

e. Regarding claims 46, 47, 53 and 54, the first layer of Itaya/Bruno reads on the AlGaN buffer 22; the second layer reads on the majority of the (Al)GaN superlattice 24; and the third layer reads on the uppermost u-GaN well of the superlattice.

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*Conclusion*

6. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

a. JP 8-23124 (made of record in IDS #21), and particularly the embodiments depicted in FIGs 5 and 6, may prove relevant to various claims depending on how Applicant amends the claims to define "thin" and "thick" layers.

b. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.



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**INFORMATION ON HOW TO CONTACT THE USPTO**

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to the examiner, **B. William Baumeister**, at **(703) 306-9165**. The examiner can normally be reached Monday through Friday, 8:30 a.m. to 5:00 p.m. If the Examiner is not available, the Examiner's supervisor, Mr. Eddie Lee, can be reached at (703) 308-1690. Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (703) 308-0956.



**B. WILLIAM BAUMEISTER  
PRIMARY EXAMINER**

B. William Baumeister

Primary Examiner, Art Unit 2815

July 12, 2003